Refine Search

Search Results -

Terms	Documents
L11 and L12	1

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Search History

DATE: Monday, May 08, 2006 Printable Copy Create Case

Set Name side by side	**Query**	**Hit Count**	**Set Name** result set
	DB=PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD; PLUR=YES; OP=OR		
L13	l11 and L12	1	L13
L12	(speed adj sensor) same (steering adj angle adj sensor)	3323	L12
L11	l9 and L10	5	L11
L10	parking adj1 assist$	674	L10
L9	l7 or L8	13	L9
L8	(6483442 6061002 6021373 6173229 20030122687 5754123).pn.	12	L8
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L7	(6061002 | 6683539 | 5754123 | 6173229 | 6021373 | 20030122687 | 6483442)![PN]	7	L7
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L6	('6898527')[ABPN1,NRPN,PN,TBAN,WKU]	2	L6
L5	(6999003 7039504).pn.	3	L5
L4	('6898527')[URPN]	2	L4
L3	l1 and L2	8	L3
L2	parking near3 vehicle	19799	L2
L1	(6898527 1170171 1327571 10264839).pn.	21	L1

END OF SEARCH HISTORY

L20: Entry 1 of 1 File: USPT Nov 19, 2002

DOCUMENT-IDENTIFIER: US 6483442 B2
TITLE: Parking aid system

Brief Summary Text (5):
A conventional parking aid system is disclosed in Japanese Patent Application Laid-open No. 11-157404 that identifies a parking space according to surrounding obstructions which are detected by, for example, a camera, radar or corner sensor. The parking aid system then calculates a recommended trajectory or locus from the current position of the vehicle to the above-mentioned parking space. The recommended trajectory is displayed over a parking space image on a display unit so as to direct the driver to, for example, steer, brake, accelerate or shift gear, and thus parking is assisted.

Brief Summary Text (6):
However, the above-mentioned conventional parking aid system requires not only various types of sensors such as cameras, radars and comer sensors for identifying a parking space, but also requires a high performance arithmetic unit for calculating the recommended trajectory from the current vehicle position to the parking space and the driving operations required to move the vehicle along the recommended trajectory. Thus, the conventional parking aid system suffers from high costs and the time required for parking is undesirably long due to a long calculation time performed by the arithmetic unit. Furthermore, if the driving operations required to move the vehicle along the recommended trajectory become complicated, the driver cannot instinctively tell whether or not the vehicle can be moved to the parking space by those operations and may feel anxious. Moreover, in using the conventional parking aid system, the driver ends up paying too much attention to the operational instructions and less attention to the surroundings of the vehicle.

Brief Summary Text (11):
In accordance with the above-mentioned arrangement, when the parking aid mode is selected, the display unit displays not only the target parking position, the subject vehicle position, and the expected parking position, but also a change in the subject vehicle position or the expected parking position relative to the target parking position accompanying the subject vehicle movement or the steering operation. The driver can thus proceed based on the above-mentioned information so that the expected parking position coincides with the target parking position, and confirm on the display unit that the subject vehicle can be moved to the target parking position by the driver's operation. The driver can thus guide the subject vehicle easily and reliably to the target parking position without feeling anxious. Furthermore, since there is no need for an image processing device for detecting the target parking position or need for calculation of the driver's operations required for moving the subject vehicle along an expected trajectory, the parking aid system can be realized with very low cost.

Brief Summary Text (34):
In accordance with the above-mentioned arrangement, since the parking aid system includes a mark that is used when stopping the subject vehicle before starting the parking assistance, the driver can easily stop the subject vehicle so that the target parking position and the subject vehicle position have a predetermined positional relationship. It is therefore possible to prevent the driver from worrying about the predetermined positional relationship being established and repeatedly adjusting the stop position of the subject vehicle due to difficulty in determining whether the predetermined positional relationship has been established.

Drawing Description Text (12):
FIG. 11 is a diagram for explaining a method of calculating the coordinates of the expected parking position;

Drawing Description Text (19):
FIG. 18 is a diagram explaining a method of calculating the coordinates of the expected parking position;

Drawing Description Text (34):
FIG. 33 is a diagram for explaining a method of calculating the subject vehicle position, the switch over position and the expected parking position;

Drawing Description Text (35):
FIG. 34 is a diagram for explaining a method of calculating the switch over position; and

Drawing Description Text (36):
FIG. 35 is a diagram explaining a method of calculating the expected parking position.

Detailed Description Text (3):
As shown in FIG. 1, a parking aid system mounted in a four wheel vehicle has a controller 1 including a microcomputer. An operation switch 2, a travel distance sensor 3, a travel speed sensor 4, a steering angle sensor 5, a reverse switch 6, a back monitor 7, a display unit 8, and a buzzer 9 are connected to the controller 1.

Detailed Description Text (4):
The operation switch 2 comprises a power switch, with which a driver switches on/off the power to the parking aid system, and a parking mode selection switch. The parking mode selection switch selects from three parking modes, that is `left reverse parking mode`, `right reverse parking mode` and `left parallel parking mode`. The parking mode selection switch is either formed from three switches so as to correspond to the three parking modes or is formed from one switch so that the three parking modes are switched in turn by pressing the one switch. Alternatively, the operation switch 2 may be formed so that one switch operates both the on/off power to the parking aid system as well as the parking mode selection. The travel distance sensor 3 calculates the distance traveled by the vehicle based on a pulse signal output accompanying rotation of the wheels. The travel speed sensor 4 calculates the vehicle travel speed by differentiating the distance traveled as detected by the travel distance sensor 3 with time. The steering angle sensor 5 detects the angle of the steering wheel steered by the driver. The reverse switch 6 detects operation of the select lever to reverse range by the driver so as to reverse the vehicle. The back monitor 7 is formed from a camera, such as, for example only, a television camera, mounted on the rear part of the vehicle and takes an image of the area behind the vehicle.

Detailed Description Text (7):
The function of the first determination means M1 is the same as that of the second determination means M2 at the reverse starting positions in all embodiments of the present invention. The reason is that although the first determination means M1 determines that the expected parking position coincides with the target parking position and the second determination means M2 determines the position where the subject vehicle changes its direction of travel from forward to backward, the above-mentioned two determinations are carried out simultaneously at the reverse starting positions.

Detailed Description Text (9):
The second cancellation means M5 cancels the parking assistance en route by operating the operating switch 2 based on the speed of travel of the subject vehicle detected by the travel speed sensor 4. The first cancellation means M4 cancels the parking aid en route by operating the operating switch 2 based on the distance traveled by the subject vehicle detected by the travel distance sensor 3 and the steering angle detected by the steering angle sensor 5. The notifying means M6 operates the buzzer 9 based on the signals from the first and second determination means M1 and M2 and notifies the driver by changing the display on the display unit 8. The functions of the above-mentioned respective means M1 to M6 are explained in further detail below.

Detailed Description Text (10):
The first embodiment of the present invention is now explained by reference to a case (FIG. 3) where left reverse parking is assisted, in which a subject vehicle travels backward from a reverse starting position and leftward to a target parking position.

Detailed Description Text (12):
In FIG. 4, if the actual subject vehicle position were displaced from the correct start position,

since the subject vehicle position on the display unit 8 is displayed at the correct start position, the actual subject vehicle position would not coincide with the subject vehicle position on the display unit 8 and the subsequent parking assistance would not be carried out appropriately. In order to achieve appropriate parking assistance, it is necessary for the driver to stop the subject vehicle at the correct start position shown in FIG. 4.

Detailed Description Text (14):
The subject vehicle position, the expected trajectory, and the expected parking position on the display unit 8 move according to the distance traveled by the subject vehicle detected by the travel distance sensor 3. A vehicle speed sensor that is used as the travel distance sensor 3 outputs a predetermined number of pulses per rotation of a wheel, and the distance traveled per pulse can be calculated from the circumference of the wheel. When the vehicle speed sensor outputs, for example, n pulses per rotation of the wheel, since each of the pulse rising edges, which is measured from an L level to an H level, or falling edges, which is measured from the H level to the L level, is counted, the number counted per rotation of the wheel is n. It is to be understood that L level represents the lowest level of the pulse and H level represents the highest level of the pulse. When the lengths of the H level and the L level of the pulses are made identical, the number counted per rotation of the wheel can be defined as 2n, thereby doubling the resolution. When the number counted per rotation of the wheel is 2n, since the circumference of a wheel having a diameter of D is .pi.D, the distance traveled .DELTA.S per count is given by .pi.D/(2n).

Detailed Description Text (15):
When the subject vehicle has reached the correct reverse starting position shown in FIG. 6 and the first determination means M1 and the second determination means M2, determine that the expected parking position has coincided with the target parking position, the notifying means M6 notifies the driver by operating the buzzer 9 for a predetermined time, for example, 1 second. The driver can therefore recognize not only from the image on the display unit 8 but also by the noise of the buzzer 9 that the subject vehicle has reached the correct reverse starting position. After the subject vehicle is stopped at the reverse starting position, when the reverse switch 6 detects that the driver has operated a select lever to reverse range and the travel distance sensor 3 detects that the subject vehicle has started reversing, the parking assistance is complete. When the parking assistance is complete, the display unit 8 stops displaying the target parking position, subject vehicle position, expected trajectory, and expected parking position and instead displays an image of the target parking position taken by the back monitor 7 (FIG. 7).

Detailed Description Text (17):
After the parking assistance is thus complete, the driver merely reverses the subject vehicle while turning the steering wheel fully to the left and the subject vehicle can thus easily and reliably be guided to the target parking position (FIG. 8).

Detailed Description Text (18):
The first determination means M1, and the second determination means M2 can determine that the subject vehicle has reached a position slightly, e.g., 50 centimeters, before the reverse starting position instead of determining that the subject vehicle has reached the reverse starting position. This is because there is slight delay before the driver stops the subject vehicle after hearing the sound of the buzzer 9. Alternatively, when a predetermined time, e.g., 3 seconds, has passed in a state in which the subject vehicle is stopped with the expected parking position coinciding with the target parking position, it can be determined that the driver has recognized that the subject vehicle has reached the correct reverse starting position and the display on the display unit 8 is changed. Furthermore, the parking assistance is suspended when the first cancellation means M4 detects that the expected parking position has passed the target parking position by 1 meter or more, when the second cancellation means M5 detects that the subject vehicle travel speed has exceeded a predetermined value, e.g. 10 km/h, when the operating switch 2 is turned off, and when the ignition switch is turned off.

Detailed Description Text (19):
The method of calculating the target parking position is now explained with reference to FIGS. 9A and 9B. The position of the vehicle is represented by a middle position \`a\` between the right and left rear wheels. In general, when the vehicle turns at a very low speed, e.g. 10 km/h or slower, at which skidding of the vehicle is ignored, the turning center C of the vehicle can be determined as follows. That is to say, as shown in FIG. 9A, when the turning angle of the front wheels is .theta.T relative to the vehicle central line and the turning center C is on an extension of the rear wheel axle, then the distance, that is, a turning radius R, from the turning center C to

the middle position `a`, which is between the right and left rear wheels, is represented by R=W/tan .theta.T where W denotes the wheelbase. When `a` is the reverse starting position and `a` is the expected parking position, the expected parking position `a'` is a position leftward from the reverse starting position `a` (in the -x direction) by R and backward from the reverse starting position `a` (in the -y direction) by R.

Detailed Description Text (23):
Initially, in step S1, the operating switch 2 is turned ON. As shown in FIG. 11, coordinate axes having their origin at the center of the entrance of the target parking position or parking space are provided, and a subject vehicle position `a` and an expected parking position `a'` are calculated and expressed in terms of (x, y) coordinates. At this point, the x coordinate xc of the subject vehicle position `a` equals L+T/2 when the vehicle width is T and the y coordinate yc equals -M when the distance between the mark and the rear wheel axle is M. The expected parking position `a'` is a position which is displaced from the subject vehicle position `a` leftward (the -x direction) by the turning radius R (=W/tan .theta.T) and backward (the -y direction) by the turning radius R (=W/tan .theta.T). The x coordinate xt of the expected parking position `a'` therefore equals L+T/2-R and the y coordinate yt equals -M-R .

Detailed Description Text (26):
In step S3, a determination is made as to whether there is no input from the travel distance sensor 3, that is, if the vehicle is stationary, step S4 confirms whether the operating switch 2 is ON. If the operating switch 2 has been turned OFF by the driver, the parking assistance is ended at this point.

Detailed Description Text (27):
If, in step S3, there is an input from the travel distance sensor 3, that is, the vehicle has started moving, the vehicle speed V is then calculated by the travel speed sensor 4 in step S5. If the vehicle speed V exceeds a vehicle speed limit VL, e.g. 10 km/h, in step S6, as there is a possibility that the calculated target trajectory might not be followed, the second cancellation means M5 ends the parking assistance. If the vehicle speed V is determined not to be above the vehicle speed limit VL in step S6 and the reverse switch 6 is not ON in step S7, that is, the vehicle is traveling forward, the coordinates of the expected parking position `a'`, which move accompanying the advancement of the vehicle, are then calculated in step S8. That is, when the distance traveled by the vehicle corresponding to one count of the pulse signal output accompanying rotation of the wheels is denoted by .DELTA.S, the x-axis component .DELTA.x of the distance traveled .DELTA.S is 0 and the y-axis component .DELTA.y is .DELTA.S when the vehicle is traveling forward. Each time the pulse signal is counted, .DELTA.S is added to the y coordinate yc of the subject vehicle position `a` and .DELTA.S is added to the y coordinate yt of the expected parking position `a'`. The coordinates of the subject vehicle position `a` and the expected parking position `a'` are thereby updated. In step S9, the subject vehicle position, the expected trajectory, and the expected parking position on the display unit 8 are updated.

Detailed Description Text (28):
Then, in step S10, the first determination means M1, and the second determination means M2, determine whether the expected parking position `a'` coincides with the target parking position. Since the y coordinate yt of the expected parking position `a'` changes in discrete steps by .DELTA.S, the expected parking position `a'` does not necessarily coincide exactly with the target parking position. A threshold value ya (.gtoreq..DELTA.S/2) is therefore employed, and when -ya.ltoreq.yt.ltoreq.ya is satisfied, it is determined that the expected parking position `a'` coincides with the target parking position. When the expected parking position `a'` coincides with the target parking position, the notifying means M6 operates the buzzer 9 in step S11, thus notifying the driver that the subject vehicle has reached the correct reverse starting position. By reversing after turning the steering wheel fully to the left at this position, the driver correctly guides the subject vehicle to the target parking position. If -ya.gtoreq.yt.gtoreq.ya is not satisfied in step S10 and, when yL is defined as a threshold value, e.g. 1 meter, yt>yL is satisfied in step S12, in other words, the y-coordinate of the expected parking position `a'` exceeds the y-coordinate of the target parking position by the threshold value yL, and the first cancellation means M4 detects the excess and ends the parking assistance.

Detailed Description Text (29):
On the other hand, when the reverse switch 6 is ON in step S7, that is to say, when the vehicle is reversing, the coordinate of the expected parking position `a'`, which moves accompanying the reversing of the vehicle, is calculated in step S13. In this case, each time a pulse signal is counted, .DELTA.S is subtracted from the y coordinate yc of the subject vehicle position `a`

and .DELTA.S is subtracted from the y coordinate yt of the expected parking position `a'`. The coordinates of the subject vehicle position `a` and the expected parking position `a'` are thereby updated. Even when the expected parking position `a'` moves past the target parking position to some extent, by reversing the vehicle, the expected parking position `a'` coincides with the target parking position. When the y coordinate yt of the expected parking position `a'` is less than 0 in step S14, it is determined that the vehicle has started reversing from the reverse starting position and the parking assistance is ended.

Detailed Description Text (31):
As described above, in accordance with the first embodiment of the present invention, it is unnecessary to employ image processing devices such as cameras, radars and corner sensors for detecting the parking space and calculate the steering operation, braking operation, acceleration, gear shift operation, and the like to move the subject vehicle to the target parking position along the expected trajectory, thereby achieving a cost efficient parking aid system.

Detailed Description Text (33):
In the above-described first embodiment, when left reverse parking is performed, the subject vehicle travels forward in a straight manner from the start position to the reverse starting position. In the second embodiment, the subject vehicle travels forward and to the right from the start position to the reverse starting position. The state at the start position is the same as that of the first embodiment shown in FIG. 4, and FIG. 12 illustrates a state where the subject vehicle has traveled forward and to the right from the start position. As the subject vehicle travels forward and to the right from the start position, the subject vehicle position is calculated based on the distance traveled detected by the travel distance sensor 3 and the steering angle detected by the steering angle sensor 5. The expected parking position is calculated when the subject vehicle is reversed with the maximum steering angle from the above-mentioned subject vehicle position as the reverse starting position. The display unit 8 displays the subject vehicle position, the expected parking position, the expected trajectory, and the target parking position. As shown in FIG. 13, the subject vehicle is stopped at the reverse starting position where the expected parking position coincides with the target parking position. By reversing the subject vehicle from the reverse starting position while turning the steering wheel fully to the left, the subject vehicle can be guided to the target parking position correctly as in the first embodiment.

Detailed Description Text (35):
After the steering angle .theta. is detected by the steering angle sensor 5 in step S15, the subject vehicle position `a` and the expected parking position `a'` are calculated in steps S8' and S13'. The sign of the steering angle .theta. is `+` when steering right and `-` when steering left. In addition, in order to simplify the calculation, the four-wheel model in FIG. 15A is replaced with the two wheel model in FIG. 15B in the present embodiment.

Detailed Description Text (46):
The subject vehicle position `a` can thus be updated by calculating the change .DELTA.x of the x coordinate and the change .DELTA.y of the y coordinate each time the pulse signal is counted and by adding these changes .DELTA.x and .DELTA.y to the coordinates (xc1, yc1) of the current subject vehicle position a1, thereby calculating the subject vehicle position `a` sequentially. At this point, a vehicle inclination of .beta.+.alpha. is used as a new inclination .beta.. In addition, since .beta.=0 at the start position, in the initialization of step S1, .beta. is set at 0.

Detailed Description Text (47):
Next, calculation of the subject vehicle position `a` when the subject vehicle reverses in step S13' is explained. As shown in FIG. 16B, using the same method as that used for calculating the subject vehicle position `a` when traveling forward, the following equations can be derived. It can be understood that the .alpha. for forward travel is replaced by -.alpha. in the case of reversing. ##EQU3##

Detailed Description Text (48):
When the coordinates of the subject vehicle position `a` are (xc, yc), .DELTA.x and .DELTA.y are calculated each time the subject vehicle reverses by a count, and the coordinates (xc+.DELTA.x, yc+.DELTA.y) obtained by adding .DELTA.x and .DELTA.y to the subject vehicle position `a` (xc, yc) are used as the new subject vehicle position `a` (xc, yc), thereby calculating the subject vehicle `a`. At this point, a vehicle inclination of .beta.-.alpha. a is used as a new inclination .beta..

Detailed Description Text (49):
Next, calculation of the expected parking position `a'` is explained. The idea is the same as that used in the first embodiment. As shown in FIG. 18, the subject vehicle reverses from the subject vehicle position `a` while maintaining the front wheel steering angle .theta. at the maximum steering angle to the left of .theta.T, and a position where the vehicle inclination becomes 90.degree. relative to the start position is an expected parking position `a'`. In detail, when the coordinates of the subject vehicle position `a` are (xc, yc) and the vehicle inclination is .beta., the x coordinate xt of the expected parking position `a'` is given by xt=xc-R cos .beta.-W/2 from FIG. 18. As is the case with the first embodiment, when xt (=xc-R cos .beta.-W/2)>-W-Foh, as shown in FIG. 18, xt=-W-Foh. The y coordinate yt of the expected parking position `a'` is given by yt=yc-(R-R sin .beta.)=yc-R(1-sin .beta.) from FIG. 18. In addition, xc, yc and .beta. can be obtained in the same manner as for the above-mentioned calculation of subject vehicle position `a`.

Detailed Description Text (50):
In step S14', if it is determined that the driver has started left reverse parking, the parking assistance is ended. That is, in the case of left reverse parking, since the driver reverses the vehicle by turning the steering wheel to the left, if the steering angle .theta. detected by the steering angle sensor 5 exceeds a predetermined value .theta.s, e.g. 360.degree., when the vehicle is reversing, it is determined that left reverse parking has started and the parking assistance is ended. As described above, since the sign of the steering angle .theta. when the steering wheel is being turned left is minus, in step S14', the determination of whether the steering angle .theta. exceeds the predetermined value .theta.s is expressed as -.theta.<-.theta.s.

Detailed Description Text (58):
When the vehicle stops at the reverse starting position and there is no input from the travel distance sensor 3 in step S3, if the reverse switch 6 is ON and reverse range is selected in step S16, the steering angle sensor 5 detects a steering angle .theta. in step S17. An expected parking position corresponding to the steering angle .theta. so detected is calculated in step S18, and this expected parking position is displayed on the display unit 8 in step S19. When the expected parking position coincides with the target parking position as a result of a steering operation in the above-mentioned step S17 and reversing is started from the reverse starting position, since there is an input from the travel distance sensor 3 in step S3 of the next loop, the routine moves on to step S5.

Detailed Description Text (59):
Calculation of the expected parking position in step S13" uses the steering angle .theta. detected in the above-mentioned step S17. The expected parking position in the case where the vehicle reverses with the current steering angle .theta. is thus displayed on the display unit 8, and the driver can thereby recognize the updated expected parking position.

Detailed Description Text (61):
The fourth embodiment of the present invention regarding parking assistance in left parallel parking is explained below with reference to FIGS. 23 to 35.

Detailed Description Text (78):
Next, a method of calculating the vehicle inclination .beta.a at the switch-over position is explained. From the geometric relationship in FIG. 33, the sum of the distance R1(1-cos .beta.a) on the x axis from the subject vehicle position `a` to the switch-over position `b` and the distance R2(1-cos .beta.a) on the x axis from the switch-over position `b` to the expected parking position `a'` equals the distance xc+T/2 on the x axis between the subject vehicle position `a` and the expected parking position `a'`. The equation below is therefore satisfied.

Detailed Description Text (81):
The subject vehicle position `a`, the switch-over position `b`, and the expected parking position `a'` thus calculated are displayed on the display unit 8 in step S22. When there is an input from the travel distance sensor 3 in the next step S23, the vehicle speed V is calculated in step S24. If the vehicle speed V exceeds a vehicle speed limit VL, e.g. 10 km/hz, in step S25, since there is a possibility that the vehicle might not follow the target trajectory, the parking assistance is ended. If the vehicle speed V is at the vehicle speed limit VL or below in the above-mentioned step S25, the steering angle .theta. is detected in step S26, if the reverse switch 6 is OFF in step S27, the routine moves on to step S28, and if the reverse switch 6 is ON, the routine moves on to step S29. The methods of calculating the subject vehicle position `a` and the expected parking position `a'` in steps S28 and S29 are the same as those in the above-mentioned third

embodiment and are therefore not explained here. A method of calculating the switch-over position `b` is now explained by reference to FIG. 34.

Detailed Description Text (82):
The method of calculating the switch-over position `b` is basically the same as the method of calculating the switch-over position `b` employed in the initialization, but is different therefrom in terms of the subject vehicle being inclined by .beta. at the subject vehicle position `a`, i.e., the reverse starting position `a`. As is clear from FIG. 34, the x coordinate xb of the switch-over position `b` is given by: ##EQU5##

Detailed Description Text (85):
Next, a method of calculating the vehicle inclination .beta.a at the switch-over position `b` is explained. From the same viewpoint as above, the sum of the distance R1(cos .beta.-cos .beta.a) on the x axis from the subject vehicle position `a` to the switch-over position `b` and the distance R2(1-cos .beta.a) on the x axis from the switch-over position `b` to the expected parking position `a'` equals the distance xc+T/2 on the x axis between the subject vehicle position `a` and the expected parking position `a'`. The equation below is therefore satisfied.

Detailed Description Text (88):
Next, in step S30, the subject vehicle position `a`, the switch-over position `b` , and the expected parking position `a'` calculated in the above-mentioned step S28 for forward travel are displayed on the display unit 8. The subject vehicle position `a`, the switch-over position `b` and the expected parking position `a'` calculated in the above-mentioned step S29 for reversing are displayed on the display unit 8 in step S30 if the steering angle .theta. in the left direction is at a predetermined value .theta.s, e.g. 360.degree. or less, in step S31. If the steering angle .theta. in the left direction exceeds the predetermined value .theta.s in the above-mentioned step S31, it is determined that reversing from the reverse starting position `a` to the switch-over position `b` has started, and the routine moves on to the flow chart in FIG. 32.

Detailed Description Text (91):
When the expected parking position `a'` has reached the target parking position in the above-mentioned step S32, the y coordinate yt of the expected parking position `a'` is compared with a predetermined limit value yL in step S33. If yt>yL is satisfied, it is determined that the subject vehicle has passed beyond an appropriate reverse starting position and the parking assistance is ended. If yt>yL is not satisfied and the subject vehicle has not passed beyond an appropriate reverse starting position, the buzzer 9 operates in step S34 in order to stop the vehicle and the routine moves on to step S35.

Detailed Description Text (92):
When there is no input from the travel distance sensor 3 in step S23 due to the vehicle stopping at the reverse starting position, if the reverse switch 6 is turned ON in step S36 and reverse range is thus selected, the steering angle sensor 5 detects the steering angle .theta. in step S37. Subsequently, in step S38 the switch-over position `b` and the expected parking position `a'` corresponding to the steering angle .theta. so detected are calculated, and the above-mentioned switch-over position `b` and the expected parking position `a'` are displayed on the display unit 8 in step S39.

Detailed Description Text (93):
The flow chart of FIG. 31 explained above illustrates the action between the time when the subject vehicle reaches the reverse starting position from the start position and stops and the time when the steering wheel is turned left to a large extent so as to start reversing. On the other hand, the flow chart of FIG. 32 following the flow chart of FIG. 31 illustrates the action between the time when the steering wheel is turned right to a large extent at the switch-over position so as to make the expected parking position coincide with the target parking position after the subject vehicle has moved from the reverse starting position to the switch-over position and the time when the parking assistance is ended. The contents of the steps with a number containing `'` in the flow chart of FIG. 32 are substantially the same as those of the steps having the corresponding number in the flow chart of FIG. 31, and the explanation therefore centers on the contents of the other steps.

Detailed Description Text (94):
FLAG in steps S40, S41 and S42 is set at 0 until the subject vehicle reaches the switch-over position as described above and is set at 1 when the subject vehicle reaches the switch-over

position. Step S40 corresponds to a case where the subject vehicle has stopped and the reverse switch 6 is ON. The switch-over position and the expected parking position are calculated in step S38a while FLAG is 0 and the subject vehicle has not reached the switch-over position. After FLAG becomes 1 and the subject vehicle has reached the switch-over position, the expected parking position alone is calculated in step S38b. Step S41 corresponds to a case where the subject vehicle is traveling forward. The switch-over position and the expected parking position are calculated in step S28a while FLAG is 0 and the subject vehicle has not reached the switch-over position. After FLAG becomes 1 and the subject vehicle has reached the switch-over position, the expected parking position alone is calculated in step S28b. Step S42 corresponds to a case where the subject vehicle is reversing. The switch-over position and the expected parking position are calculated in step S29a while After FLAG becomes 1 and the subject vehicle has reached the switch-over position, the expected parking position alone is calculated in step S29b.

Detailed Description Text (95):
It is determined in step S43 whether or not the subject vehicle has reached the switch-over position. This determination is carried out by comparing the subject vehicle inclination .beta. with the pre-calculated inclination. .beta.a at the switch-over position. If .beta. exceeds .beta.a at the switch-over position, since the subject vehicle cannot be guided to the target parking position even by subsequently turning the steering wheel rightward to the maximum steering angle, it is necessary to determine whether or not the subject vehicle has reached the switch-over position before .beta. exceeds .beta.a. It is therefore determined that when .beta.a.gtoreq..beta..gtoreq..beta.a-.DELTA..beta. is satisfied, the subject vehicle has reached the switch-over position. As described above, when the change in angle when the vehicle moves by a distance corresponding to one count of the pulse signal with a maximum steering angle is expressed as a, the above-mentioned .DELTA..beta. is a change in angle slightly larger than ax. If the determination condition is set as .beta.a.gtoreq..beta..gtoreq..beta.a-.DELTA..beta., the value of .beta. when a certain pulse signal is output can therefore be guaranteed to always fall between .beta.a and .beta.a-.DELTA..beta., and it can be determined accurately whether or not the subject vehicle has reached the switch-over position.

Detailed Description Text (96):
First, if .beta..gtoreq..beta.a-.DELTA..beta. is not satisfied in step S43, it is thus determined that the subject vehicle has not reached the switch-over position and FLAG is set at 0 in step S44. If .beta..gtoreq..beta.a-.DELTA..beta. is satisfied, it is determined that the subject vehicle has reached the switch-over position and FLAG is set at 1 in step S45. After FLAG is set at 1 in the above-mentioned step S45, if .beta.a.gtoreq..beta. is satisfied in step S46, the buzzer 9 operates in step S34' to notify the driver that the subject vehicle has reached the switch-over position. If the subject vehicle has passed beyond the switch-over position and the inclination .beta. exceeds a limit value .beta.L in step S47, since it is impossible to guide the subject vehicle to the target parking position, the parking assistance is ended.

Detailed Description Text (97):
When the subject vehicle reaches the switch-over position and stops, the driver turns the steering wheel to the right to a large extent to make the expected parking position coincide with the target parking position and then starts reversing towards the target parking position. As a result, it is detected in step S31' that the steering angle .theta. has exceeded a predetermined steering angle .theta.s, e.g. 360.degree., and the parking assistance is therefore ended at this point. The target parking position, the subject vehicle position, the expected trajectory and the expected parking position that have been displayed on the display unit 8 are replaced with an image of the area behind the subject vehicle taken by the back monitor 7.

Previous Doc Next Doc Go to Doc#

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Set Name side by side	**Query**	**Hit Count**	**Set Name** result set
DB=PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD; PLUR=YES; OP=OR			
L20	l15 and L19	1	L20
L19	chang$3 adj2 direction	176137	L19
L18	l15 and L16	0	L18
L17	l16 and L16	177	L17
L16	output adj (yaw near2 sensor)	177	L16
L15	l13 and L14	1	L15
L14	calculat$	1708154	L14
L13	l11 and L12	1	L13
L12	(speed adj sensor) same (steering adj angle adj sensor)	3323	L12
L11	l9 and L10	5	L11
L10	parking adj1 assist$	674	L10
L9	l7 or L8	13	L9
L8	(6483442 6061002 6021373 6173229 20030122687 5754123).pn.	12	L8
DB=PGPB,USPT; PLUR=YES; OP=OR			
L7	(6061002 | 6683539 | 5754123 | 6173229 | 6021373 | 20030122687 | 6483442)![PN]	7	L7
DB=PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD; PLUR=YES; OP=OR			
L6	('6898527')[ABPN1,NRPN,PN,TBAN,WKU]	2	L6

L5	(6999003 7039504).pn.	3	L5
L4	('6898527')[URPN]	2	L4
L3	l1 and L2	8	L3
L2	parking near3 vehicle	19799	L2
L1	(6898527 1170171 1327571 10264839).pn.	21	L1

END OF SEARCH HISTORY